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ABSTRACT

A classroom/lab-based graduate telecommunications course was studied to discover implications for online instruction of related topics and skills. The analysis focused on: (1) examining the potential for teaching telecommunications via an Internet-mediated virtual classroom to public school personnel situated at their home districts; and (2) considering methods for using student learning assessment information gathered online in evaluating and adjusting the learning process. The proposed model emphasizes experiential learning, supportive collegial interaction, and meaningful and useful learning assessment. Learning Process Control (LPC), an adaptation for education of TQM's Statistical Process Control (SPC), is introduced as a visual-analytical method for evaluating the learning progress of large numbers of distant students and for using online information to continuously improve the learning process. Appendices provide the telecommunications course schedule and a chronological topic sequence. (Contains 24 references.) (Author/AEF)

THE VIRTUAL CLASSROOM, AUTHENTIC ASSESSMENT, AND LEARNING PROCESS CONTROL IN ONLINE TEACHER DEVELOPMENT TO SUPPORT INTERNET TELECOMMUNICATIONS IN EDUCATION

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Abstract

Internet telecommunications is one of the most powerful of emerging educational technologies and many school districts are exploring access to Internet communications for their personnel. However, the challenges of developing the capacities of large numbers of teachers' for using telecommunication and integrating it into instruction are great. Without effective means of developing teachers to use these technologies comfortably and effectively, successful adoption in the classroom is problematic.

This project sought to examine the potentialities and problems for online training and development of large numbers of teachers located at their home districts at widely distributed sites via an Internet mediated Virtual Classroom scenario. An established classroom/lab based telecommunications course was examined to discover implications for online instruction of related topics and skills. The proposed model of training in telecommunications capabilities for teaching and classroom research via the Internet emphasizes experiential learning, supportive collegial interaction, and meaningful and useful learning assessment. Methods of authentic learning assessment using information gathered online and of using assessment information for adjusting the individual learning process as it proceeds are discussed. Learning Process Control (LPC), an adaptation for education of TQM's Statistical Process Control (SPC), is introduced as a visual-analytic method for evaluating the learning progress of large numbers of distant students and for using online information to continuously improve the ongoing learning process.

Introduction

During the Spring Semester of 1995, a research project was undertaken to examine the potentialities for developing a program of training for the purpose of broad scale, online instruction of public school personnel to support the introduction of telecommunications technologies in Mississippi public schools. The State of Mississippi was, at the time of this research, preparing to make available substantial funding to support the acquisition, development, and implementation of new technologies in schools. Technology planners were becoming increasingly aware of the need for extensive and effective training of school personnel for new technical resources, including telecommunications, to result in fully realized benefits for students.

Internet telecommunications is one of the most powerful of emerging educational technologies. Many school districts are developing access to Internet communications for their students and personnel. Without effective means of training teachers to use these technologies comfortably and effectively, however, successful adoption in the classroom is improbable. The challenge of simultaneously developing a large number of teachers' capacities for using telecommunications and integrating it effectively into instruction is daunting.

Telecommunications is a complex new subject area with which most teachers are not at all familiar. Relevant staff development needs will be widespread throughout the educator population. These requirements pose a serious problem to education planners and managers. The prospect of providing effective and timely technological training and development for thousands of teachers using conventional classroom or workshop based resources and methods does not seem promising due to limitations of locally situated telecommunications resources and trainers. This research investigated issues related to the alternative possibility of developing effective telecommunications training for teachers online using the communications resources of the Internet to address large numbers of learners simultaneously.

The potentiality for employing wide-area telecommunication systems for training and development of school personnel in Mississippi has been enhanced by recent funding allocation decisions. A portion of the state funding for educational technology development has been allocated for the development of a statewide network of telecommunication hubs which will substantially enhance the opportunities for public school systems throughout the state to acquire broad bandwidth, high speed connections to the Internet at realistic costs. This development presents the possibility that a large number of schools will acquire technical connection to the Internet much sooner that they will be able to develop their teachers' capacities to utilize its resources

in their instruction. Extending training to a large number of educators via the Internet for the systematic development of their telecommunications knowledge and ability appears to be a logical and expeditious means of staff development in this situation. Issues related to this idea motivated the present research project.

A number of learning programs providing online telecommunications training have been offered via the Internet in recent years. Typically, such programs have primarily involved one-way communication with learners and have relied on the individual determination and motivation of learners to carry them through the learning process. Learning materials have been presented via the Internet for learners to apply in a self-paced and self-motivated learning process. This is quite different from the typical classroom learning situation in which two-way and multi-way communications and interrelationships involving students and teachers provide teachers with immediate knowledge of how well students are learning and provide students with readily available support from teachers and peers. This research examined issues relevant to the possible use of wide-area, multi-way online communication for providing learning experiences with strong learner support. The specific focus of online training here is the simultaneous training of large numbers of distant learners in the use of telecommunications for education.

The approach of this research project was to examine closely an established telecommunications course's content and methods to attempt to identify and understand factors which might contribute to effective online training of classroom teachers in the use of telecommunications technologies. The subject of the research project was a three semester hour credit, graduate level university course entitled **Telecommunications: Applications in Scholarship**. The Telecommunications course was developed and instructed by Dr. John Perry of the Department of Technology and Education at Mississippi State University.

This course was chosen for analysis because: 1. it is directly relevant to the training of education personnel in telecommunications topics and abilities, 2. it has been shaped over several semesters by experience with the evolving technologies it addresses and with the responses of students to the course's content, materials, and presentation methods, and 3. it inherently involves authentic assessment via students' online performance activities. These characteristics were considered to offer potentially useful guidance to the development of effective online instruction in telecommunications for educators.

This analysis had two focuses:

1. Examination of the course's implications for effectively teaching telecommunications material partially or entirely online via the Internet for the development of relevant skills and capacities among public school personnel situated at their home districts.

2. Consideration of methods for using student learning assessment information gathered online in assessing and adjusting the learning process as it proceeds.

Both of these research focuses were also consistent with research and development activities sponsored by the Program of Research and Development for Public Schools, Inc. (PREPS) of Mississippi State University. The first focus relates to the effort undertaken by PREPS to participate in the support of school districts as they pursue the planning and implementation of technology innovations including telecommunications. The second focus relates to the **Learning Process Control** project, a research strand of PREPS which has investigated using assessment information to continuously improve ongoing learning processes.

Lessons From The Historical Failure of Educational Technology Innovation

A principal motivation of this research derived from concerns related to the frequent failures of previous efforts to implement significant applications of technology in education. Instances of resistance to the adoption of change are abundant in the history of technology innovation in education (Cohen, 1987; Cuban 1986; Hodas, 1993). Cuban (1986) has reviewed the history of such failed efforts to reform education throughout a series of various technologies including motion picture film, audio technologies, television, satellite distance education, computers, and other technologies. Cuban's history presents a recurrent pattern of great expectations by technology innovators followed by ineffective adoption efforts producing disappointing results with minimal implementation of the target technologies in the classroom.

Efforts to effect technological innovation in public education have usually been initiated by technology proponents from outside of the K-12 educational system (Cohen, 1987; Cuban, 1986; Hodas, 1993; Papert, 1980; Skinner, 1968). Hodas (1993) observes:

> For nearly a century outsiders have been trying to introduce technologies into high school classrooms, with remarkably consistent results. After proclaiming the potential of the new tools to rescue the classroom from the dark ages and usher in a new age of efficiency and enlightenment, technologists find to their dismay that teachers can often be persuaded to use the new tools only slightly, if at all. They find further that, even when the tools are used, classroom practice--the look and feel of schools--remains fundamentally unchanged. (p. .

Despite the best efforts of technology innovators, their change programs have been frequently and consistently neutralized by attitudinal, affective, and behavioral impediments at the classroom level (Cohen, 1987; Cuban 1986; Hodas, 1993).

Many explanations and analyses have been brought forward to account for, and perhaps attempt to allay, the persistent reluctance of education to adopt and be transformed by technological innovations and related change programs. Cuban (1993) has explained the general resistance in teacher behavior to radical change in terms of "situationally constrained choice" (p. 206). Cuban (1986) applied the concept of situationally constrained choice to explain reluctant teacher response to new technologies:

> ...because of severe restraints imposed on teachers by the classroom and school as work places and the imperatives of their occupational culture, teachers will seek out those tools that meet *their* tests of efficiency: Is it simple? Versatile? Reliable? Durable? What is the personal cost in energy versus return in worth for the students? Will these new machines help solve problems *teachers* (and not nonteachers) define? (p. 66).

Hodas (1993) has offered the alternative view that teacher reluctance to adopt new technologies is driven by "situationally induced adaptation," a process of, "gradual adaptation and acquiescence to the values and processes of the organization" (p. 8), which are inherently conservative and resistant to change. Hodas finds a source of "technology refusal" in a condition of incompatibility of values inherent in new technologies with the established cultural values of school systems and classrooms.

Cohen (1987) sees problems resulting from the powerful flexibility and ready adaptability of new technologies to the established needs and constraints of the classroom. Highly flexible contemporary technologies are, according to Cohen, more likely to be adapted by practitioners to conform to, and leave unchanged, existing educational practices than they are to alter them.

Smith (1995) asserts that the failure of schools to change is related in part to the intrinsic and unavoidable complexity of education and its institutional systems. This complexity introduces chaotic forces and processes into the concert of drives that affect school reform efforts, defeating systematic change programs. However, Smith observes that, "The educational system may not be amenable to change, but people are" (p. 590). This sentiment is echoed when Waterman (in Foster, 1986) says, "...technology is housed in the skills of people. People must change in order for a company to embrace a new technology" (p. 17) and also when Hall and Hord (1987) say that, "For schools to improve, teachers must change" (p. 5). Hall and Hord elaborate:

> To change something, someone has to change first. The ultimate effectiveness of an innovation depends on whether teachers and others change to incorporate the new practice. Thus, attention must be given to individuals and their nonuse/use of the new practice.... (p. 10)

What emerges from these observations is the impression that effective implementation of technologies in schools must involve intense consideration of not only the behavior but the personal experiences of the individuals involved, including the teachers who will make the final decision as to whether to embrace, adopt, and apply new technologies wholeheartedly.

With the foregoing observations in mind, teacher training for technology can be considered from an expanded perspective. Conventional practices of teacher training for technology innovation in schools have not produced a favorable record of success in encouraging adoption. The usual approach to training is restricted to imparting discrete instrumental knowledge and developing specific skills concerning the operation and application of new technologies in various aspects of education. Consideration of the processes of personal change in which teachers must engage to adopt new technologies is generally not considered in teacher technology training. The analyses of technology rejection discussed above indicate the need for a more encompassing conception of personnel development supporting personal, individual change efforts and experiences in the implementation of technology innovations such as telecommunication in education.

Telecommunications: Applications in Scholarship

In the Fall Semester of 1993, a new credit course in the scholarly applications of wide-area telecommunications, developed and taught by Dr. John F. Perry, was offered for the first time by the Department of Technology and Education at Mississippi State University as a Special Problems course. The Telecommunications course has been

offered every regular term and summer session since its introduction and has expanded to multiple sessions each term.

In 1994 the course was approved as a regular credit course entitled **Telecommunications: Applications in Scholarship**, with the designation TKT-8733. The course has offered experiential learning to university students in accessing and using telecommunications resources via the Internet for the support of research and other academically and professionally relevant activities. Most of the participants in the course have been graduate students pursuing Masters or Doctoral degrees in a variety of fields with approximately half of the students majoring in some area of education. The course has evolved over time and has been modified by Dr. Perry as the sophistication of available telecommunications and Internet resources has advanced and the number of online functions and services has increased.

Method

The subject of the observational component of this research was the Telecommunications course itself. The course was examined in terms of its structure, content, organization, sequence, methods of instruction, methods of assessment, and uses of assessment information. The research did not address issues of course effectiveness or involve consideration of student performance and learning.

Both researchers had previously been students in the course during earlier terms. For this project, one of the authors researched the Telecommunications course as a participant observer, engaging in ongoing classroom activities throughout one semester. The participative investigation was augmented by document review and interviews with the course instructor, who also served as the supervisor of the research activity. Copies of all formal course materials were obtained, including informational handout materials, authentic learning activity instructions, and formal examinations. The class participant researcher met periodically throughout the semester with the teacher/supervisor to discuss various aspects of the course and seek further understanding of the methods and content of the course. Pertinent literature was reviewed concerning the diffusion of innovations and teacher change associated with technological innovations. Relevant literature pertaining to authentic modes of learning assessment and uses of assessment information, including the methods of Statistical Process Control, was also reviewed.

Results of Telecommunications Course Observations

The Structure of the Telecommunications Course

TKT-8733 is a three semester hour laboratory and lecture course which is primarily oriented toward active, hands-on experiential learning. During regular semesters, the class meets for three hours one evening per week. Additional lab hours are available for students utilize on a voluntary basis. The course covers a number of different specific Internet communications methods, tools, and resources with an emphasis on their use to support academic scholarly and professional pursuits.

The course is taught in a computer laboratory/classroom which is equipped with twenty IBM compatible personal computers operating under Microsoft Windows. The computer work stations are connected to a local area network (LAN) operating on Novell system software. The LAN is connected via fiberoptic cable to the campus Computer Center which provides a link to the Internet operating in a Unix environment.

Each student in the class works at a separate computer work station during class sessions. Each student is assigned an individual Internet address. A listserv for the class is established each term by the teacher for group communication among the teacher and students. The teacher communicates course relevant information and several assignments via e-mail during the term. In addition, students communicate with the teacher and with each other via e-mail. This mode of communication is an essential ingredient of the course and is a significant medium for student support and problem solving. Each class is made up of approximately twenty students per term.

Telecommunications Course Implementation

At the first class meeting, the instructor provided a course syllabus and calendar schedule of topics to be presented (See Appendix A). He suggested to the class that the schedule was to be considered tentative insofar as his previous experience indicated that each class tends to cover topic material at different rates. In interviews with the researcher, the teacher observed that among the Telecommunications classes he has taught to date, he has noted unique combinations of subject majors among the various groups with consequent diverse patterns of ability, prior knowledge, and computer expertise within the class memberships. Such complex and changing patterns of ability and knowledge among classes from term to term require that the teacher exercise flexibility in his dealings with students and topic presentation to accommodate the needs and strengths of each group and each individual. Translating this kind of classroom-centered flexibility and individual accommodation to the arena of

online instruction of a large, geographically distributed learner group presents a significant methodological challenge.

A detailed chronicle of the course material as it was actually covered in sequence during the first twelve weeks of the semester is presented in appendix B. This listing indicates that the topics dealt with fell into two major categories: 1. telecommunication resources and applications and, 2. Unix system commands useful or necessary for the effective use of the telecommunications system. In addition, significant course events (examinations, activities, etc.) are indicated. The balance of the semester was applied to the completion of a major course project and the final examination.

The telecommunications course is organized in a logical progression beginning with elementary introduction to the basic functions of electronic mail and several essential Unix commands and tools. The sequence of topics thereafter progresses through somewhat more specialized applications and functions including electronic file transfer (ftp) and the operation of remote computers (telnet). Toward the end of the sequence, graphic user interfaces are introduced in connection with hypertext and hypermedia applications on the World Wide Web (WWW). A final project involves the development of personal WWW "home pages" by each student.

Along with each successive application topic, pertinent new concepts and phenomena are introduced including graphic file protocols, file compression standards, directory and file structures, access privileges, and hypertext markup language (see Appendix B). The progression of students through the learning sequence constitutes an incremental process of acquiring an *expanding*, rather than merely extending, array of interrelated information about telecommunications. Various aspects of computer system technology and software that are necessary for learners to acquire a genuinely powerful command of the medium are also covered. Prior topics lay the foundation for learning subsequent ones. The early introduction of electronic mail in the course provides an essential tool for immediate, active engagement of students in online activities. This medium of communication allows students to seek information and support as it is needed, and also enables the teacher and other students to provide supportive information and guidance.

Each new topic area and related level of material to be dealt with in the learning sequence presents novel ideas and practices which can be daunting to computer novices. The instructor has found that close individual support to students grappling with new telecommunications topics is essential to their successfully negotiating their way to eventual mastery. He departs occasionally from the course's prescribed

sequence to ensure that early learnings are mastered before advancing to new topics. This responsiveness requires close attention to evidence of progress or difficulty demonstrated by individual learners in the classroom. The teacher explained in interviews with the researcher that he paid close attention to the appearance and behavior (facial expressions and other non-verbal communications) of his students, as well as their direct requests for assistance, to be aware of the progress of their learning or of any problems they may have with the course materials and activities.

The chronology of subject material dealt with in sequence (see Appendix B) illustrates that some procedures and topics were dealt with multiple times. This repeated coverage of material had several motivations. In some instances, specific functions or topics (e.g., file and directory access privileges, data compression) had an evolving meaning to students as more advanced operations were learned. In these instances, the teacher reintroduced previously covered material to expand students' understanding of new implications for their advancing use of telecommunications. In other instances, the teacher reviewed material when he became aware that students had not fully understood or mastered it in earlier presentations.

During the course, students were provided with a series of performance activities to provide practice using Internet tools and to explore online resources. These activities often required students to submit the results of their efforts to the teacher via e-mail or by file transfer. These results were not used as a formal part of the course's summative evaluations. However, the results were used by the instructor for informal formative evaluation of how individual and group learning was progressing.

Formal tests for both formative and summative assessment of student learning were also authentic in character. The results of these tests became part of the basis of grading for the course. Because of the opportunity for face-to-face interaction between teacher and student, much formative assessment of student progress was based on personal observation and interaction. To monitor learner progress in the environment of online personnel training, more assessment information will be necessary in terms of quantity, frequency, and formal analysis.

Discussion

Telecommunications via the Internet is one of the most powerful of the currently emerging educational technologies. Many school districts are exploring the means of extending access to Internet communications to their students and staffs. However, the challenge of developing the knowledge and practical capacities of teachers to support their use of telecommunications and the effective integration of its resources into their

instructional methods is great. Without effective means of developing teacher capabilities to use the technologies and to address a range of impediments to technological innovation in schools, the chances of successful adoption of new technologies in the classroom is slight, as has been repeatedly demonstrated in the history of educational technology innovation.

Implications from the classroom experience are directly relevant to the prospect of educating school teachers online who are not technologically sophisticated regarding the use and value of telecommunications to their instruction and to their students' learning. Each new topic introduces novel terminology and procedures and requires some struggle to master. Frustration on the part of students is likely to accompany this process. In these transitions in learning, the availability of some form of direct and immediate support is essential to promote student effort and success. In the classroom/lab situation, the instructor is immediately available to students and, significantly, so is the advice and support of other students. For online personnel development training to be effective, adequate means of sensing student problems and responding to them via distance methodologies must be developed and employed.

Analyses of previous failures of technological innovation and evidence of the Telecommunications course classroom experience described above are consistent in indicating that successful adoption of new technologies requires consideration of personal, individual change factors. The Concerns Based Adoption Model (CBAM) provides an instructive theoretical framework for the consideration of online telecommunication instruction of teachers when it is conceived of as a process of technological innovation involving individual change.

Teacher Concerns in Educational Technology Innovation

The Concerns Based Adoption Model or CBAM (Hall and Hord, 1987) is a model of innovation adoption related to educational change which explicitly focuses on the personal experiences of individuals dealing with innovations. CBAM was developed by researchers at the Austin, Texas based Research and Development Center for Teacher Education. It provides a theoretical framework, a research supported change/adoption model, and a set of assessment instruments and procedures for investigating educational change and innovation adoption processes. The CBAM includes a theory of Stages of Concern which provides a developmental model of individual concerns related to innovation adoption. This theory and model have been supported by empirical development and testing over a span of more than two decades with respect to a wide variety of educational innovations, including but not limited to technological ones (Hall and Hord, 1987).

Stages of Concern theory is grounded in a set of basic assumptions about change related to innovation:

> ...change is a process, not an event; change is made by individuals first, then institutions; change is a highly personal experience; and it is developmental in nature. (Nielsen and Turner, 1985, p. 752)

Bailey and Palsha (1992) elaborate, "The Concerns-Based Adoption Model is premised on the assumption that change is an ongoing, personal experience, the effectiveness of which is mediated by the extent that training is matched to the needs and concerns expressed by individual trainees" (p. 227).

According to the Concerns-Based Adoption Model (Hall and Hord, 1987), the developmental change process is characterized by the progression of participants through a sequence of seven predominating "concerns." Specifically, individuals dealing with an innovation typically progress through up to seven predominating Stages of Concern (SoC) from the earliest stage of (0) Awareness, associated with the initial introduction of the innovation, through six successive stages: (1) informational, (2) personal, (3) management, (4) consequence, (5) collaboration, and (6) refocusing. A further typology groups the seven Stages of Concern into descriptive categories as follows: **Self Concerns** comprised of stages 0 through 2, **Task Concerns** of stage 3, and **Impact Concerns** including stages 4 through 6. Descriptions of the Stages of Concerns have been briefly summarized by Wedman, Heller, and Strathe (1986, p. 70-71) thusly:

Stage	Title	Definition
0	Awareness	Unaware of or unconcerned about the innovation.
1	Information	Concerned about the general characteristics of the innovation.
2	Personal	Concerned about the relationship between one's role and the demands of the innovation.
3	Management	Concerned about the management and organization of the innovation.
4	Consequences	Concerned about the impact of the innovation on student outcomes.
5	Collaboration	Concerned about working with others using the innovation.

6	Refocusing	Concerned about something better than the innovation.

Introduction of an innovation initially evokes the earlier concerns. The teacher seeks to satisfy the concerns that are predominant. As they are satisfied, the teacher progresses developmentally through later concerns. Although more than one type of concern may be felt by an individual at any one time, CBAM concerns theory holds that the earlier stages of concern tend to subside in importance before the later concerns become predominant.

The CBAM model further proposes that, in order for teacher change interventions (personnel development, training, etc.) to be effective in encouraging adoption of innovations, they must be congruent with the stage(s) of concern which are predominant in the teacher's individual experience at the time of the intervention. If they are not so congruent, the training intervention will be ineffective (Chicelli and Baecher, 1989; Hall and Hord, 1987). The CBAM change model, if used as a guide for technology related school change efforts (Hall and Hord, 1987; Hord, Rutherford, Huling-Austin, and Hall, 1987) will shape the training interventions applied to develop teachers' capabilities to use the technologies.

These theoretical factors guided consideration of the potential application of telecommunications for developing teachers' abilities and willingness to use Internet communication for education. According to CBAM theory, effective application of telecommunications to teacher change, in common with any other personnel development training, would have to take into consideration teachers' individual experiences as they progress through various Stages of Concern in accordance with their learning about and experience with the innovation involved. Only when the learner has progressed past the early, difficult, sometimes anxious stages of learning the mechanical use and practical management of telecommunications technology can he or she give consideration to the applications and impact of it in the classroom.

Consistent with the CBAM model, experience with the Telecommunications course has indicated that novices to telecommunications require substantial individual support addressing personal and management level concerns. Confusion and self-doubt are often obstacles to learning for novice students of telecommunications. However, the classroom experience has also demonstrated that adequately supported experiential learning in this area can provide rapid progress and the achievement of comfort with the technology leading to full adoption and effective professional use of telecommunications. Such individualized support in the classroom Telecommunications course has been delivered primarily via face-to-face interactions

between student and teacher and between student and student, supplemented by some supportive communication via e-mail. In the classroom, the teacher is in a position to observe learners directly, to sense individual concerns, and to respond to them. Extending such responsiveness to learners engaged in distance learning within the online environment and without direct personal contact is challenging.

Several significant obstacles face the prospect of extending adequately supported, concerns-appropriate online telecommunications training to large numbers of learners. First, an environment of responsive support must be made available. Second, means are needed for assessing what concerns are predominant among learners at various times. Third, methods of tracking student learning as it progresses are needed. Finally, means of knowing when students are failing to progress as desired and expected, are necessary.

The development of a supportive and information intensive learning environment is discussed in terms of a conceptualization of the Virtual Classroom. Adaptation of CBAM assessment methods to online implementation is considered as a means of knowing learners concerns. Finally, the process of monitoring and using information about learner progress is discussed in connection with the concept of Learning Process Control.

The Virtual Classroom as a Supportive Learning Environment

The term "Virtual Classroom" has become commonplace in the discussion of applications of distance technologies including telecommunications to education. In general, the Virtual Classroom is a learning environment which enlists communications and computing technologies to develop extended communities of learners, teachers, and various information and knowledge resources in the service of expanded opportunities for active, participative learning. Wesley and Franks (1994) have described specific characteristics of a concept of the Virtual Classroom which are relevant the process of online teacher development training:

> The Virtual Classroom is a classroom without walls. It is an electronically networked educational venue with human and technical resources for conveying knowledge, skills, and understanding to learners via telecommunication on a local, regional, or more wide-area scale. It is, in principle, unbounded by geography, organizational area, or any physical limits. It is extensible in space, continuous in time, and flexible in organization.

The Virtual Classroom will serve the purpose of all classrooms - to provide an environment and resources for the acquisition and conveyance of new knowledge. However, in several respects, the Virtual Classroom differs significantly in concept and operation from the conventional one:

* The Virtual Classroom is expandable in time, space, and content.

* The informational territory of the classroom can grow indefinitely as new knowledge and resources are acquired and as the capabilities of new members are added.

* The Virtual Classroom has continuity through time. It is not limited to conventional academic time segments (semesters, school years, etc.). As successive groups of learners are added, previous learners need not leave but can remain to continue their learning and to support the learning of the "new students."

* Any member of a Virtual Classroom can be in contact with any member of any other connected classroom, whether virtual or physical, so that information and problem solving capabilities can be mutually shared and reinforced through collaborative interconnection (p. 6-7).

While the Virtual Classroom, as described, is widely applicable to learning in almost any subject area, the interest here is in the training and development of school personnel to use telecommunications competently and effectively. Use of telecommunications to develop school personnel telecommunications capabilities will constitute an active, participative, and supportive learning environment. Learners can seek and provide mutual support addressing any topic area or concern throughout the learning process. In addition, the learning process in the Virtual Classroom environment can extend in time as long as desired, through as many technological developments or stages of concern as necessary, even beyond the end of any formal developmental training program. Learners will not merely acquire instrumental abilities and skills, but will be enabled to change themselves from people who do not use telecommunications to ones who do. Sustained professional development is an integral and natural potentiality in the Virtual Classroom.

This learning process, therefore, uses the tool (telecommunications) to improve the use of the tool, thereby increasing the capabilities of the tool users over time. The interaction of teachers with other teachers, via the Virtual Classroom, will constitute a situation in which the sharing of problem solving information and ideas among

professional peers can occur naturally and become self-reinforcing. This is important because, by CBAM theory, the progressive learning of teachers in the use of telecommunications technology will advance them from predominant early stages of concern for personal adjustment and management of the innovation to concerns for the impact of the technologies on student learning and to considerations of related collegial cooperation and further innovation. Furthermore, as Wedman, Heller, and Strathe, 1986, p. 69) have suggested, early concerns may actually be refreshed and sustained in adopters, rather than subside as CBAM theory proposes, because the innovation itself changes in adopters' perceptions as they experience an evolving understanding of it. The realization of new uses of a familiar innovation may maintain the arousal of early stage concerns while later stage concerns become elevated as well.

Arousal of later concerns may well not occur until after a formal telecommunications training program has ended. But the Virtual Classroom can endure and support sustained professional development for as long as desired. Mutual and authoritative support via volitional use of telecommunications contacts can and probably must accommodate evolving, developmental concerns and needs on the part of online learners for the developmental progression of concerns to occur. The potentialities of the Virtual Classroom and teachers' progression to later (e.g., Consequence, Collaboration) concerns can converge to address the effective integration of telecommunications into teaching and learning.

> Beyond acquiring essential technical competencies for telecommunication (e-mail, file transfer, remote access to information and computer resources, etc.), teachers have to develop knowledge and abilities to make effective use of telecommunications resources and services in their classroom instruction. By engaging in active and cooperative learning experiences during training, teachers can learn of the availability of extensive information sources available to them and their students via telecommunication. The teachers so engaged can easily serve as resources to each other, forming a virtual community of professionals with like challenges and interests. This is a process which can lead to a change of organizational values and culture from one which avoids the application of technologies in the classroom to one which applies telecommunication, and related computer-based technologies, as a matter of course. Further, through first-hand experience of telecommunication, teachers can experientially learn how readily the usual limitations of the classroom are cast off by the presence of a link to the outside world that can be used creatively and at will by students (Wesley and Franks, 1994, p. 7-8).

Online Assessment of Teacher Concerns

The developers of CBAM have developed a set of methods and instruments for assessing the Stages of Concern of people involved in adopting innovations. These methods include unstructured and semi-structured interviews and the use of a Stages of Concern Questionnaire (SoCQ) which has been assessed for reliability and validity in a number of innovation situations (see Hall and Hord, 1987, pp. 61-70). Adaptation of these methods and instruments to online communication may provide instructors with a means of assessing initial and later concerns of learners as they undertake distance training associated with the adoption of technological innovations.

The Stages of Concern Questionnaire or SoCQ (Hall, George, and Rutherford, 1977) consists of thirty-five items according to which individuals can rate on an eight-point scale the extent to which they feel statements about a specific innovation are characteristic of their own feelings at a given point in time. For example, a high rating of agreement with a statement such as "I am concerned about what will happen to my job if I can't master this innovation" (a contrived example not in the questionnaire) would contribute to a high Personal concerns score. Questionnaire scores provide a quantified individual Concerns Profile which can be graphically represented. The Concern Profile chart illustrates clearly the predominant and subordinate concerns held by a respondent at the time of administration of the questionnaire.

The SoCQ could readily be adapted to online administration via e-mail. Mass administration via the Internet could be performed at the beginning of a development program and, if desired, at selected times throughout the training process. The questionnaire can be directed at a general conception of an innovation (e.g., telecommunications in the classroom) or to specific aspects of the innovation (e.g., e-mail, graphical user interfaces). Individual concerns profiles can be compared to identify subgroups of students who may be at different stages of predominating concerns, and can be aggregated to form average group profiles. Interpretation of group and individual concerns profiles could enable instructors of a training and development program to direct the emphasis of their instruction to address the reported Stages of Concern of students, in keeping with the precepts and prescriptions of CBAM theory. In addition, consideration of individuals' Stages of Concern could enable effective linking of learners via telecommunications for peer-to-peer assistance and support. This would be consistent with the Virtual Classroom's capacity for collegial interaction and professional peer support via electronically mediated networking. It would also provide experiential learning related to one of the most powerful potentialities of telecommunications - the construction of a support system for continuing learning within an extended community of learners. Such an online support

community could enhance the prospect for teachers advancing to the later concern stages of Consequence, Collaboration, and Refocusing long after the formal training episode.

Mass administration of the SoCQ to numerous students would produce a large amount of data which could only be practically processed into usable information by computer analysis. If the instructor were to make use of a number of periodic administrations of the questionnaire, programs to automate the receipt and processing of online data would almost certainly be necessary. However, it is likely that a single administration early in the program to assess initial Stages of Concern may provide enough information for the instructor to ensure that the presentation of information and learner activities address the predominant concerns of individuals and groups at the outset. Less formal means of assessing concerns, equivalent to online unstructured or semi-structured interview methods, may be adequate to sustain teachers' apprehension of learner concerns, especially if the teacher can target a smaller subset of learners who may be demonstrating problems with their progress in the development process for closer assessment.

Learning Process Control: Statistical Process Control in the Teaching-Learning Situation

The Learning Process Control (LPC) project of PREPS is an ongoing inquiry into the feasibility of adapting the concepts and methods of Statistical Process Control (SPC) to the teaching-learning situation. This inquiry seeks to examine the possibility of applying Statistical Process Control tools to develop appropriate measures of student performance and to use assessment information to improve the learning process for both individual learners and groups as that process proceeds. The methodology of control charting has been a focus of special attention.

The classroom Telecommunications course demonstrates several characteristics which may be especially amenable to online LPC application. First, the learning environment is technologically supported, since both learning and assessment activities are effected on computers and related communications technology. Second, the assessment activities employed in the course are inherently authentic. Students learn and employ telecommunication skills, including the capabilities for e-mail communication; information search, access, and retrieval; remote computer operation; and the use of the Internet and its resources for research and educational work. Students' success in learning these skills is directly evidenced in authentic activities which they perform online. Measurement of such assessment activities and the processing of such measurements for online telecommunications training of teachers

will require novel approaches to deal with large learner groups and the mass of information to be produced. Also, the quantification of results of performance-based learning activities presents methodological challenges.

Applications of TQM/SPC methods to industry, business, education, and other fields have been discussed extensively elsewhere (e.g., Blumberg, 1989; Fields, 1994, 1993; Latta and Downey, 1994). Statistical Process Control methods, now elaborated to include a number of analytical tools, originated with the work of statistician Walter Shewhart on statistical control of industrial processes (see Wheeler, 1995). SPC methods involve the statistical analysis of measurement data which represent the performance of production processes. The data analyses of SPC serve to demonstrate the stability and effectiveness of production processes and to provide information to support problem solving when processes are unstable or unsatisfactory. Also, SPC analyses can assist managers and practitioners in improving the effectiveness of production processes in creating high quality products or services by identifying and reducing the sources of variation of their performance.

Most considerations of SPC in relation to education are imbedded in discussions addressing improvement of management and administrative functions and organizational effectiveness through Total Quality Management prescriptions. Administrative and organizational aspects of education bear sufficient similarity to business and industrial management to permit a relatively straightforward application of SPC practices. Application of SPC to the learning situation (e.g, the classroom), however, is less frequently addressed in the literature and requires considerable adaptation to a situation very different from that of business and industry production. Examination of TQM/SPC in its more traditional fields of business and industrial production (Montgomery, 1991; Wheeler, 1995, 1993) demonstrates that conventional production processes differ from learning related processes of education in several important ways. Pursuing continuous process improvement via SPC methods in learning situations requires some adaptation of measurement and analysis methods from those applied in manufacturing and business settings.

The challenge to the use of Statistical Process Control methodologies in education derives from salient differences between educational "production" and manufacturing production. In manufacturing, the goal of production is to create products which comply with design specifications with as little variation from item to item as can be achieved under real-world circumstances. In education, such uniformity of outcome is not a realistic goal considering the uniqueness of individual learners. The goal of education is, ideally, to advance each individual learner from an initial level of

knowledge and ability to the highest level of learning or accomplishment the individual can achieve.

Another important difference distinguishes the standards, practices, and realities of learning situations from those of manufacturing and business. Total Quality Management and SPC in industrial and business settings couch many of their prescriptions in terms of a distinction between the "Voice of the Customer", the ultimate source of product or service specifications, and the "Voice of the Process", the variability of the process which generates the product (Wheeler, 1995, 1993). This distinction of customer from process (and producer) is possible in the business arena and is adaptable to educational organizational management and administration processes (see Fields, 1994, 1993). However, this distinction does not generalize well to the educational learning situation. Efforts in learning situations to discriminate between the customer and process, and between the product, process, raw material, and producer inevitably founder on the complexity and uniqueness of educational reality.

Rather than applying the conventional business/industrial metaphor directly to learning processes, a more adequate conception for education is that raw material, producer, process, product, and customer are all centered on one entity - the student or learner. These roles cannot be distinguished from one another in the educational learning situation. Educational learning "production" is more properly seen as a process whereby students (as producers), exert effort to transform themselves (the raw material) into advanced, more learned and capable versions of themselves (the product) for their own benefit (the customer). These various roles are inseparable in the learning (and personnel development) situation. In this production context, the role of the teacher, though not central (the learner is central) is clearly critical. The production by the student of an advanced version of himself or herself is greatly aided by strong, responsive support from a teacher. Furthermore, the role played by peer learners emerges as tremendously important, illuminating the value of collaborative learning relationships.

This view of the learning process applied to personnel development is consistent with the conception of staff development as a process of personal change, as held by CBAM theory. For online telecommunications development of teachers, the potential of the Virtual Classroom for enabling teacher-student and student-student communications and relationships supporting learners' efforts to "produce" themselves as effective adopters of the relevant technologies is substantial. The potentialities of electronic mail alone offer vast opportunities for active multi-way communication of

information, assignments, student reactions, ideas, inquiries, requests for assistance, and other relevant communications.

Online Assessment of Student Progress

In addition to offering a community of learners for mutual support, network communication can aid in accommodating the requirements for formative assessment of student work. Such formative assessment is essential for teachers to know how well students are doing in order to pace and direct their ongoing learning experiences most effectively (Valeri-Gold, Olson, and Deming, 1991). Dealing with the abundant information load of such assessment in a distributed learning situation can be supported by online practices of assessment and computer assisted data analysis.

For example, wide-area network communications can enable students to participate in peer evaluation for formative assessment activities. This would enable students to assess and critique each other's work and would directly contribute to the development of the desired learning community and to learners' experience with it. Further, it would enable the frequent assessment of student work with minimal information processing burden for the instructor. For this practice to produce sufficient information to be effective, the process would have to provide more information and more frequent assessment than is formally done in the classroom Telecommunications course. This is necessary to compensate for the lack of personal, face-to-face contact between teacher and learners. The potential for such information density exists in the current course procedures, however.

Effected online, each authentic learning activity can be utilized as an occasion for assessment. As an example, students could e-mail other students the results of their performance activities which could, in turn, be assessed quantitatively via the use of guided or cued rating procedures. Though the issue of quantification of authentic work is challenging, the use of ratings of work is one method which can be used. Students performing assessments would rate other students' work using guidelines provided by the teacher which describe specific dimensions or characteristics of the work to rate (e.g., "The activity results are complete.", "Activity results indicate that the student has correctly compressed file X, transferred it via FTP to the designated recipient, and received a reply". Such cued rating would support reliability of the rating procedure. The results of peer assessment could then be electronically transmitted from student assessors to the teacher for analysis. Further reliability could be realized from the practice of having all student work assessed by several raters each and examining the means and dispersions of ratings. These suggestions are speculative

and effective procedures will have to be worked out in practice. However, the potentialities of wide-area electronic communication for the support of peer assessment appear promising.

SPC Analyses of Online Data for Control Charting

Of particular potential analytical usefulness for providing teachers with accurate and current knowledge of the stability and adequacy of their learning programs is the SPC method of control charting (Wheeler, 1995, 1994; Latta and Downey, 1994; Blumberg, 1989; Brown, 1986). Control charts are graphical representations of quantitative process information about events taking place over time. As the learning process proceeds, assessment measurements can be statistically computed into readily interpreted control charts to inform the teacher virtually at a glance if their learning process (the training program) is functioning stably, subject only to acceptable levels of natural variation, or is being perturbed by "special causes" of variation. If the system of learning is sufficiently stable, it is said to be in "statistical control" and the teacher is in a position to interpret student performance data as reflecting performance in the acceptable range or as requiring special intervention. Without such stability, data cannot be assumed to represent student performance meaningfully and investigation must be done to identify the causes of excessive variability in data. Also, with statistical control, the teacher can, in concert with the learners, attempt to improve the effectiveness of the learning process to further reduce variation in learner accomplishment.

Since the learning activities and assessments involved in telecommunications training are "authentic" or performance-based, methods such as the rating process described above are necessary to quantify results to provide data for control chart analysis. In traditional (e.g., industrial) production applications, measurements taken for control charting are as concretely and logically related to specified criteria of quality as possible. In education, the use of authentic methods of measurement of learning best approximates this standard.

The LPC concept has been viewed as a method for application with a high level of technological support, whether in the conventional or virtual classroom. A basic practice of control charting is to present information to production operators and decision makers in readily interpreted visual form on a real-time basis. Graphical data representation supports rapid interpretation and responsive adjustment of production processes in the interest of maintaining process control, thereby enabling maintenance and improvement of quality. Appropriate graphical representation helps operators and managers interpret complex information in minimal time. This practice requires

computer-based technological support for fast, accurate analysis of measurement data and the rapid development and presentation of useful information.

Summary and Recommendations

This research sought to examine the potentialities of distributed instruction for teacher development online via the Internet emphasizing supportive interaction, experiential learning, and meaningful and useful learning assessment. The content and methods of an established Telecommunications course were examined to guide the consideration of issues. Prospects and problems for offering telecommunication training online to school personnel in their home districts at geographically widely distributed sites were examined. Relevant methods of learning assessment using assessment information gathered online were considered. Methods of using assessment information for adjusting the individual learning process as it proceeds were examined. The concept of Learning Process Control (LPC), an application for education of Statistical Process Control (SPC), was discussed as a method for assessing the learning process involving large numbers of distant students using online assessment information.

The focus of the analysis was to discover lessons and implications for instruction via the Internet for personnel development with special attention to the need for supportive interaction with students, especially in the early stages of the learning process. The Concerns Based Adoption Model (Hall and Hord, 1987) provided a theoretical framework for this analysis.

Effective implementation of online telecommunications training of teachers will require developing and evaluating methods for assessing learning of telecommunication knowledge and skills based on authentic performance assessment. Means for quantifying performance-based information will be necessary to support the application of Statistical Process Control methods such as control charts for visual presentation and interpretation of learning process and student performance information. The development of a community of learners via the Virtual Classroom model of online collaborative learning will serve the interest of assessment by enabling the large scale use of peer assessment. Further, the Virtual Classroom will provide an environment of mutual support and problem solving assistance to encourage learner success. Future Developments in telecommunication resources and technologies may radically change the content to be addressed in staff development. However, the principles proposed concerning online personnel development are general and will apply to changing telecommunications technologies and resources.

Bibliography

Bailey, D. B, & Palsha, S. A. (1992). Qualities of the Stages of Concern Questionnaire and implications for educational innovations. Journal of Educational Research, 85(4), 226-232.

Blumberg, C. J. (1989). Applying statistical process quality control methodology to educational settings. Paper presented at the annual meeting of the American Education Research Association, San Francisco, CA, March 27-31, 1989. ERIC Document Retrieval Service No. 306-285.

Brown, H. H. (1986). Statistical process control: impact and opportunities for Ohio. Westerville, OH: Ohio State Council on Vocational Education. ERIC Document Retrieval Service No. 289-078.

Cicchelli, T. & Baecher, R. (1989). Microcomputers in the classroom: focusing on teacher concerns. Education Research Quarterly, 13(1), 37-46.

Cohen, D. K. (1987). Educational technology, policy, and practice. Educational evaluation and policy analysis, 9(2), 153-170.

Cuban, L. (1993). How teachers taught: constancy and change in American classroom 1880-1990 (2nd ed). New York: Teachers College Press.

Cuban, L. (1986). Teachers and machines: the classroom use of technology since 1920. New York: Teachers College Press.

Fields, J. C. (1993). Total quality for schools: a suggestion for American education. Milwaukee: ASQC Press.

Fields, J. C. (1994). Total quality for schools: a guide for implementation. Milwaukee: ASQC Press.

Foster, R. (1986) Innovation: the attacker's advantage. New York: McKinsey & Company.

Hall, G. E., George, A. A., & Rutherford, W. L. (1977). Measuring stages of concern about the innovation: a manual for use of the SoC Questionnaire. Austin: Research and Development Center for Teacher Education, University of Texas at Austin. ERIC Document Reproduction Service No. 147-342.

Hall, G. E., & Hord, S. M. (1987). Change in schools: facilitating the process. Albany, NY: State University of New York Press.

Hodas, S. (1993). Technology refusal and the organizational culture of schools. Educational Policy Analysis Archives [On-line serial] 1(10). Available E-mail: LISTSERV@ASUACAD.BITNET Message: GET HODAS V1N10 F=MAIL.

Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G.E. (1987). Taking charge of change. Alexandria, VA: Association for Supervision and Curriculum Development.

Latta, R. F. and Downey, C. J. (1994). Tools for achieving TQE. Volume 10 of the series "Total quality education for the world's best schools", Larry E. Frase, Ed. Thousand Oaks, CA: Corwin Press. ERIC Document Retrieval Service No. 378-651.

Montgomery, D. C. (1991). Introduction to statistical quality control (2nd ed). New York: John Wiley & Sons, Inc.

Papert, S. (1980). Mindstorms: children, computers, and powerful ideas. New York: Basic Books.

Skinner, B. F. (1968). The technology of teaching. New York: Meredith Corp.

Smith, F. (1995). Let's declare education a disaster and get on with our lives. Phi Delta Kappan, 76 (8), 584-590.

Valeri-Gold, M., Olson, J. R., & Deming, M. P. (1992). Portfolios: collaborative authentic assessment opportunities for college developmental learners. Journal of Reading, 35 (4), 298-305.

Wedman, J. F., Heller, M. O., and Strathe, M. I. Changes in teachers' concerns about educational computing. Computers in the Schools, 3(2), 63-71.

Wesley, M. T., Jr. and Franks, M. E. (1994). The virtual classroom and vertically integrated technology training for education: new paradigms for telecommunications technology training for school personnel. Paper presented at the annual meeting of the Mid-South Educational Research Association, Nashville, TN, November 9-11, 1994. ERIC Document Reproduction Service No. 382-174.

Wheeler, D. J. (1995). Advanced topics in statistical process control: the power of Shewhart's charts. Knoxville, TN: SPC Press, Inc.

Wheeler, D. J. (1993). Understanding variation: the key to managing chaos. Knoxville, TN: SPC Press, Inc.

Appendix A
(Telecommunications Course Schedule)

Appendix B
(Chronological Topic Sequence)

Applications	System (Unix)	Event
Class # 1		
		Introduction of course; introduce text; preliminary assessment of knowledge of telecommunication terms and concepts. Introduction of all students; "getting to know you" exercise.
Class # 2		
E-mail	Finger; finger-m, lookup; w (what); login name; login to host system procedure; setting password	"Personal characteristics" test; additional introductions of new students; distribute and review syllabus; review content and sequence of course; reading assignment; distribute "Electronic Mail and System Functions" handout; lecture on basic e-mail and telecommunications terms and concepts; discuss local system; Internet accounts and addresses (structure and designations)
Class # 3		
list communications; mailing lists; discussion groups; listservs; Pine e-mail program (folders,	% prompt; pathname structure; Internet addresses; modem connection to terminal	

composing messages, forwarding messages, responding to a message, deleting text, sending messages, cut-uncut text, keyboard lock in Pine, specified recipient, reading in a e, read only mode, mailing list in Pine, address book, multiple recipients); Pico text editor	servers (TS1, TS2); .signature file; up and down arrows; list commands (ls, ll, ls-a); review of finger and Specified finger command with more detail; more command; pipe; multiple logons; ps command; Kill command; man (on-line manual; .plan and .project files; text editing; review lookup and what commands	
Class # 4		
E-mail (Pine, continued)	finger; who am I; whoami; lookup; w (what); whois; kill; ls; ll; ls-a; hidden (.) files; creating a public directory; setting file and directory access privileges; chmod; home directory; directory structure; more and less commands; IP addresses; passwd; cd; tilde (~); pwd; history; up and down arrow keys; changing to remote public directory; reading files in remote directory; checking privileges in remote directory; requirement of privileges for remote access/reading of files; read/write/execute	In-class e-mail activities, review

	privileges; man (manual); cal (calender)	
Class # 5		
Gopher	who am I; whoami; finger; lookup; w; ping; file/directory permissions; tilde in pathname; talk; ntalk; ytalk	Quiz #1 on e-mail; distribute handout on Gopher
Class # 6		Distribute Gopher activity instructions; review several system commands
Gopher; Veronica (search engine)		
Class # 7		
Gopher FAQ; wording Veronica Searches; introduce File Transfer Protocol (FTP and ftp); anonymous and non-anonymous ftp; ftp passwords; specifying target host; ftp help; binary and ascii file transfer modes; Archie (search engine); pwd; ls; dir; hash; open; add; |more (pager); get; e-mail (including file in a document: export function in Pine	mv (move) to rename a file; cp (copy); link	review of previous Gopher activities; distribute handout for introduction to FTP; Gopher activity assignment to be distributed to class by e-mail. Take-home Gopher test handed out
Class # 8		
Archie; case insensitive search; data		Administer Gopher test in class; review Gopher

uncompress; data untar; gzip and gunzip compression; ascii and binary data transfer modes. Introduce telnet		test; review on-line Gopher practice activity. Distribute FTP/Archie information sheet
Class # 9		
FTP and Archie review; Archie set pager command; traceroute command; -s (set search type) command; lcd; mget; pipes (|); more command in Archie; File compression protocols (Z, z, zip; tar; gzip); retaining text file formatting (ps-postscript, rtf-right text formatting, binary data transfer mode). Introduction to Network News (nn) and tin		
Class # 10		
Network News; Usenet; tin; y; /; search methods (group, thread, and reading levels); changing levels; posting to news groups; setting specified text editor for composing and posting messages; g (go to) command; test groups	modifying .cshrc file; set env command; talk; ntalk; ytalk; finger; w; date; history; cal	Distribute information handout for Network News; distribute nn activities sheet
Class # 11		

Introduction to World Wide Web (WWW); http; url; html; Netscape; Mosaic; multitasking in Windows for html editing; basic html homepage composition; WWW searching; Webcrawler (search engine); keyword search; html editors	review chmod and privileges	Distribute handout on creating a home page and "A Beginner's Guide to HTML"
Class # 12		
html; searching for and downloading graphics for homepage use; searching for usable images; Netscape and downloading of files		